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# Electrical resistivity contrast between active layer and frozen ground: why is it similar for different sites over many order of magnitudes ?

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Geophysical techniques are widely used to detect and characterise permafrost. Among them, electrical methods such as Electrical Resistivity Tomography (ERT) or Vertical Electrical Soundings (VES) , which measure the electrical resistivity of the ground, have a very long and successful tradition in all kind of permafrost applications in polar, mountain and subsea terrain. Similarly, electromagnetic methods, which measure the inverse of resistivity, the electrical conductivity, are more and more used for permafrost applications.

The reason for the good applicability lies in the fact that the electrical resistivity of most materials increases sharply at the freezing point. The nature of this increase is due to several processes such as the reduction of the electrically conducting liquid water content during phase change and the reduced mobility of the ions in the liquid phase. How much the resistivity increases upon freezing depends therefore on the specific physical properties of the material (e.g. porosity, pore water resistivity), which can be completely different for the different permafrost environments and lithospheric materials.

On the other hand, when plotting the resistivity of the active layer against the resistivity of the frozen layer for a multitude of data sets, most permafrost occurrences follow a similar quantitative relationship, although their lithopsheric and geomorphological characteristics are very different. In this contribution we will analyse the reasons for this relationship using theoretical considerations and verify it with a newly compiled resistivity data set of more than 100 permafrost occurrences.